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# APPENDIX 1

## SYPHON PERFORMANCE TESTS REPORT

Pat Hulme, June, 1985

Head/discharge relationships for syphons commonly used for irrigation in the Macquarie Valley are not locally available. To overcome this, a number of syphons were recently tested at the New South Wales Department of Agricultures' hydraulics laboratory at the Murrumbidgee College of Agriculture, Yanco.

### Materials and Methods

Syphons were tested by syphoning water from a tank into which water was pumped through a flow meter (Fig. 1). The syphon outlet was submerged in a lower tank which was level, giving a long crest over which the water flowed. Static head was measured as the difference in water level between the two tanks. If the syphon outlet is not submerged, static head is measured from the lowest point where the syphon is flowing full. During the tests, the static head varied from 70mm to 500mm.

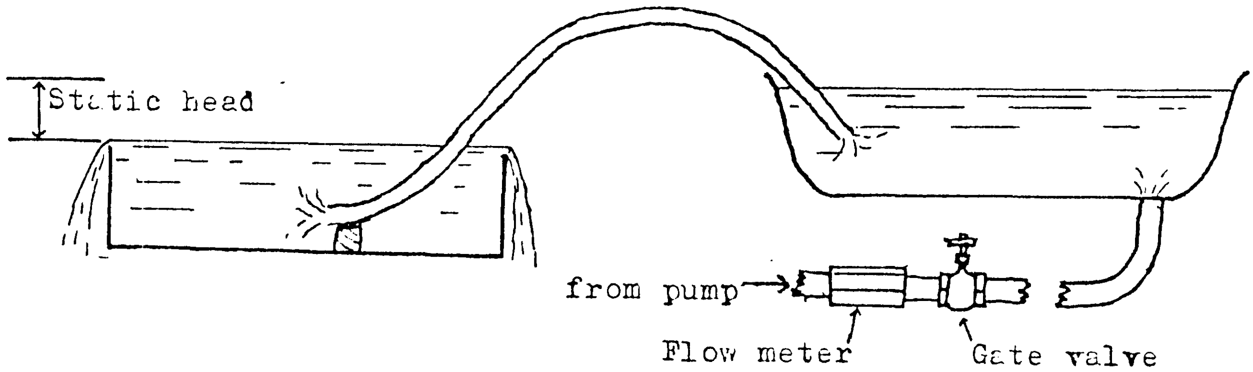



FIGURE 1. Diagramatic layout for conducting syphon performance tests.

Values of static head(H), and discharge(Q) for each syphon were fitted to equations of the form:

Q = m*H**b    m and b are constant for each syphon. Correlation coefficient, r, was calculated for each syphon.

### Results

Discharge of each syphon varied with the square root of the static head (Table 1, Fig. 2).

Of the series of three 50mm aluminium syphons tested, the syphon with small dings gave the same discharge as the undamaged syphon for all heads. The third syphon, in which the cross sectional area was less than half normal for part of its length suffered a 30% reduction in discharge.

Discussion

The significance of discharge increasing with the square root of head is seen in Fig. 3. For the 70mm "Agroflex" syphon, increasing the head from 100mm to 200mm gives a 1.0 l/sec discharge increase (2.5 to 3.5 l/sec). However, increasing the head from 400mm to 500mm gives a much smaller increase of 0.6 l/sec (5.0 to 5.6 l/sec).

The head discharge/relationship obtained in this test is similar to that predicted by the Hazen and Williams formula (Hagan, Haise, and Edminster(1967)). For pipe flowing full the formula simplifies to :

Q = K*H**.54   K is a constant dependant on pipe size, pipe roughness, and the units of measurement used.

Variation of b in Table 1 is due to the high proportion of total head loss caused by turbulence as water enters and leaves the syphon. These losses are equivalent to friction loss in 2m of the 18mm syphon ranging up to 6m of 99mm syphon (Schwabb, Frevert, Edminster, and Barnes(1981)).

When using head/discharge relationships from this report, it is more accurate to use the formulae of Table 1 than the graphs of Fig. 2. If discharge is desired in units other than l/sec, multiply m in Table 1 by the appropriate factor in Table 2. Similarly, if head is desired in units other than mm, multiply m in Table 1 by the appropriate factor in Table 2 raised to the power b in Table 1.

Acknowledgements

These tests were conducted with the guidance and assistance of Ross Arnold, and Mike Darnley-Naylor, Murrumbidgee College of Agriculture.

References

Hagan, R.M., Haise, H.R. and, Edminster, T.W. (1967) Eds. 'Irrigation of Agricultural Lands'. American Society of Agronomy, Madison Wisconson. 1180 pp.

Schwabb, G.O., Freveret, R.K., Edminster, T.W. and, Barnes, K.K. (1981). 'Soil and Water Conservation Engineering' 3rd Ed. Wiley, Brisbane. 525pp.

| Syphon material | Length (metres) | Bore (mm) | m | b | Correlation coefficient |
|---|---|---|---|---|---|
| Convoluted Agroflex | 3.5 | 37 | 0.05338 | 0.501 | 0.9999 |
| Convoluted Garnite | 2.2 | 58 | 0.1898 | 0.480 | |
| Convoluted Agroflex | 3.4 | 70 | 0.2573 | 0.496 | 0.999 |
| Smooth polythene | 2.6 | 18 | 0.01396 | 0.529 | 0.99995 |
| | 2.4 | 45 | 0.1060 | 0.518 | |
| | 2.3 | 75 | 0.3860 | 0.504 | 0.99996 |
| Aluminium | 2.3 | 35 | 0.07000 | 0.521 | |
| | 2.3 | 50 | 0.1219 | 0.524 | 0.999999 |
| | 3.0 | 74 | 0.2920 | 0.518 | |
| | 3.4 | 99 | 0.4912 | 0.505 | |
| Aluminium (small dings) | 2.3 | 50 | 0.1258 | 0.519 | 0.999 |
| Aluminium (large dings) | 2.3 | 50 | 0.08810 | 0.542 | 0.999996 |

Table_1 Head/discharge relationships for syphons tested in June,1985, and in 1977 by Murrumbidgee College of Agriculture students. m and, b are coefficients in the formula: $Q = m*H**b$ where Q is discharge (litres per second) and H is static head (mm)

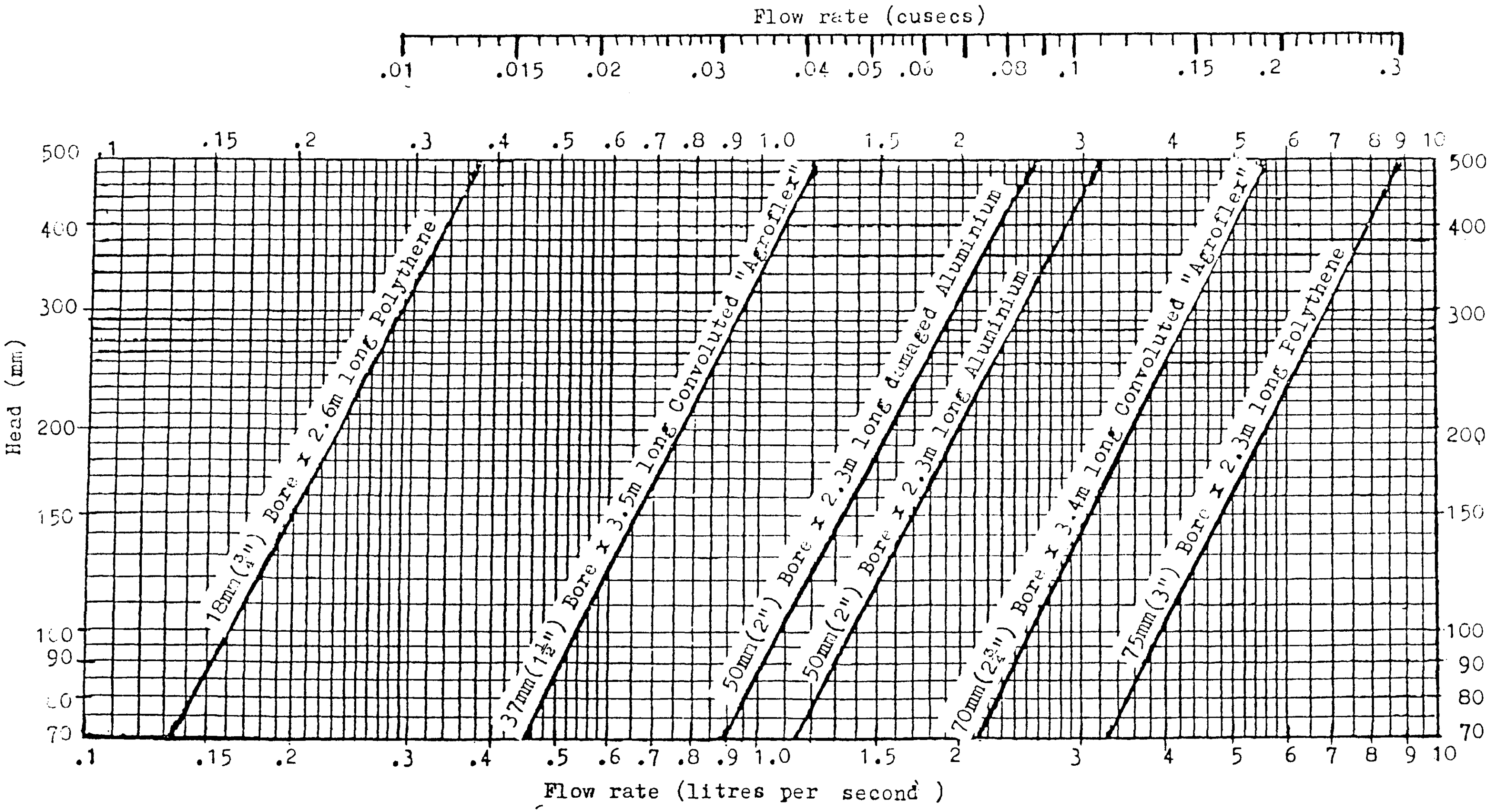
(i) Factor to convert l/sec to alternartive discharge units

| cubic metres per sec | Megalitres per day | Gallons per min * 1000 | Cubic feet per sec | Acre feet per day |
|---|---|---|---|---|
| .001 | .08640 | .01320 | .03531 | .07005 |

(ii) Factor to convert mm to alternative head measurements

| centimetres | metres | feet | inches |
|---|---|---|---|
| 10 | 1000 | 304.8 | 25.40 |

Table_2 Conversion factors




SYPHON PERFORMANCE TEST CHART

Figure 2

Results of tests performed at Murrumbidgee College of Agriculture on 28/6/85.

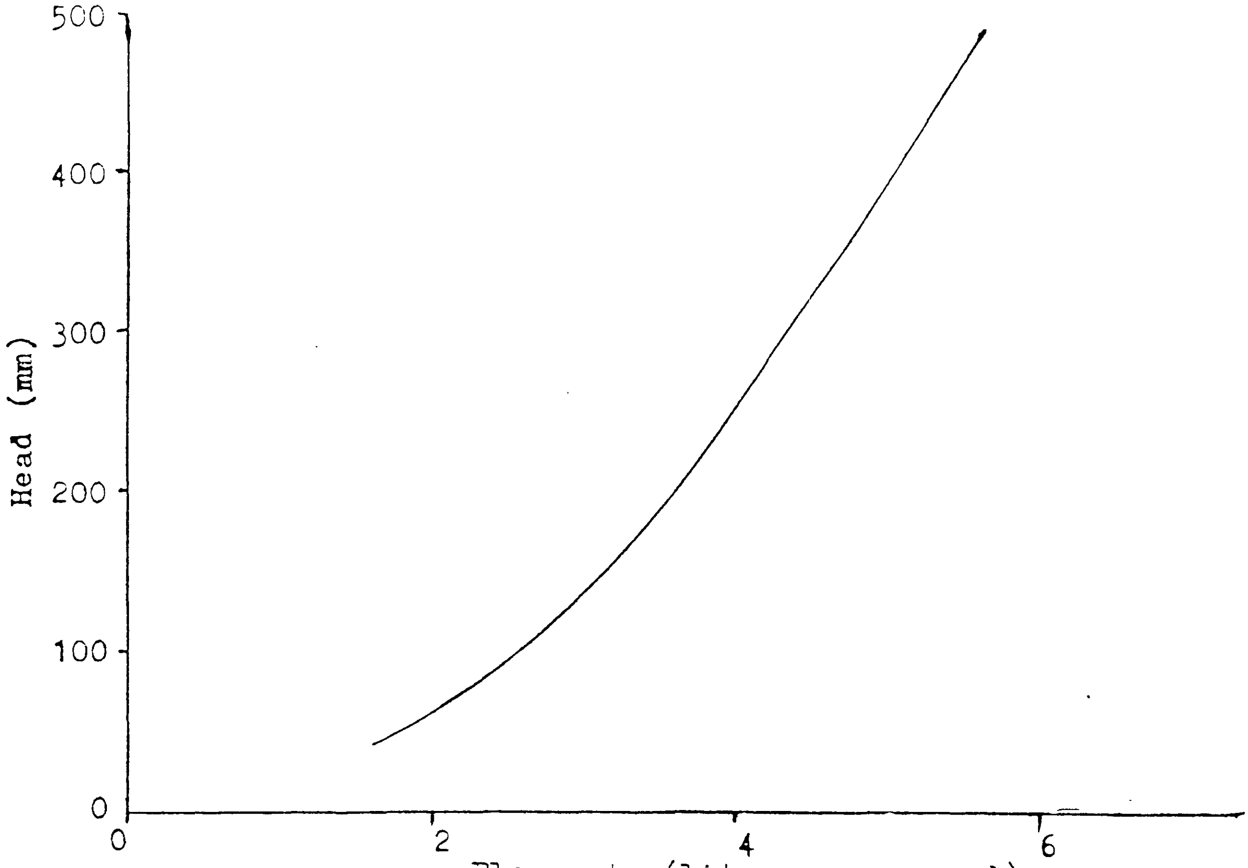



Figure 3

Discharge of 70mm bore x 3.4m long convoluted "Agroflex" syphons as a function of head.

# APPENDIX 2

## Glossary of cotton growing terms

Chisel: deep tillage treatment in which tines spaced at 0·3 m work at 0·25 m.

Cultipacker: steel roller used for breaking up clods and consisting of a number of steel rings 5 cm wide rotating on an axle with an outside diameter 15 cm smaller than the inside diameter of the rings. The difference in diameters of the rings and axle allows the rings to follow the surface of the hills.

Cultivator: rowcrop tillage implement using knives to remove weeds and alabama sweeps to reform furrows (Figures A2.1 and A2.4a).

Direct listing: a tillage treatment in which listing (see below) is not preceded by subsoiling.

Furrow: depression formed by the listing operation for irrigation drainage and wheel traffic.

Go devil: rowcrop disc tillage implement used for hilling and weed control in preformed hills and producing a fine tilth prior to planting (Figures A2.2 and.A2.4b).

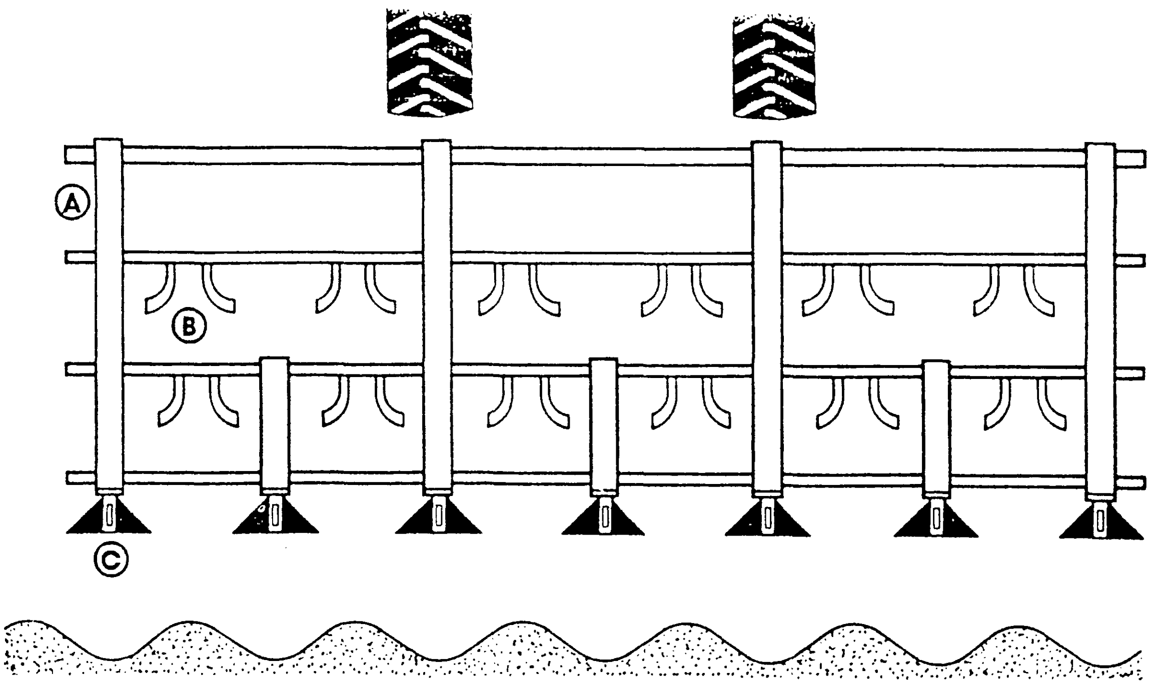



**Figure A2.1** Six row cultivator, plan view. (A is sled toolbar, B are knives and C is alabama sweep) (from Napier Grasslands Ltd. rowcrop equipment catalogue (1986)).

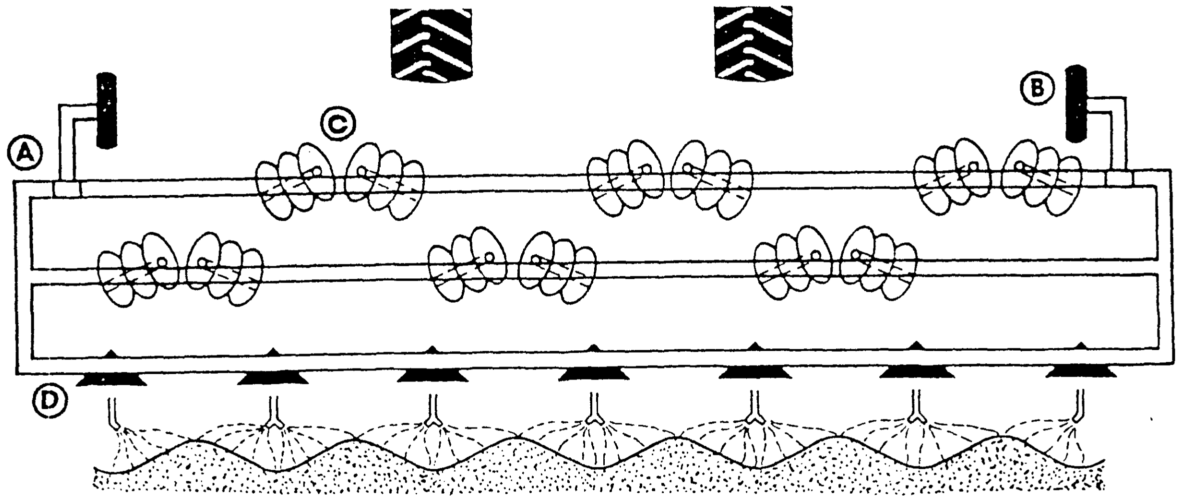



**Figure A2.2** Six row go devil, plan view. (A is main frame, B are depth wheels, C are three disc go devils and D is alabama sweep) (from Napier Grasslands Ltd. rowcrop equipment catalogue (1986)).

Grade: a classification given to ginned cotton after comparison with prepared samples and based on colour of lint and amount of trash and short fibres in samples. Grades classed from poor to good include: good ordinary, strict good ordinary, low middling, strict low middling, middling, strict middling and good middling.

Head ditch: ditch carrying water to the high end of the field from which the water flows into the furrows through syphons described in Appendix 1.

Hill: 20 to 30 cm high ridge formed by listing operation on which row of cotton plants is grown.

Lilliston. rowcrop rotary tillage implement used to remove small weeds, aerate the soil and produce a fine tilth (Figures A2.3 and A2.4d).

Listing: a tillage and landforming operation using a tool which splits the soil and turns two furrows laterally in opposite directions leading to a hill and furrow soil configuration.

Micronaire: a measure of the fineness of cotton lint fibres expressed in micrograms of lint per inch of fibre. Micronaire of Australian cottons normally varies from 3·5 to 5·0, with lower values normally indicating immature fibre (Hearn, 1985).

Permanent beds: a tillage system in which the hill and furrow configuration is left in the same place for a number of crops.

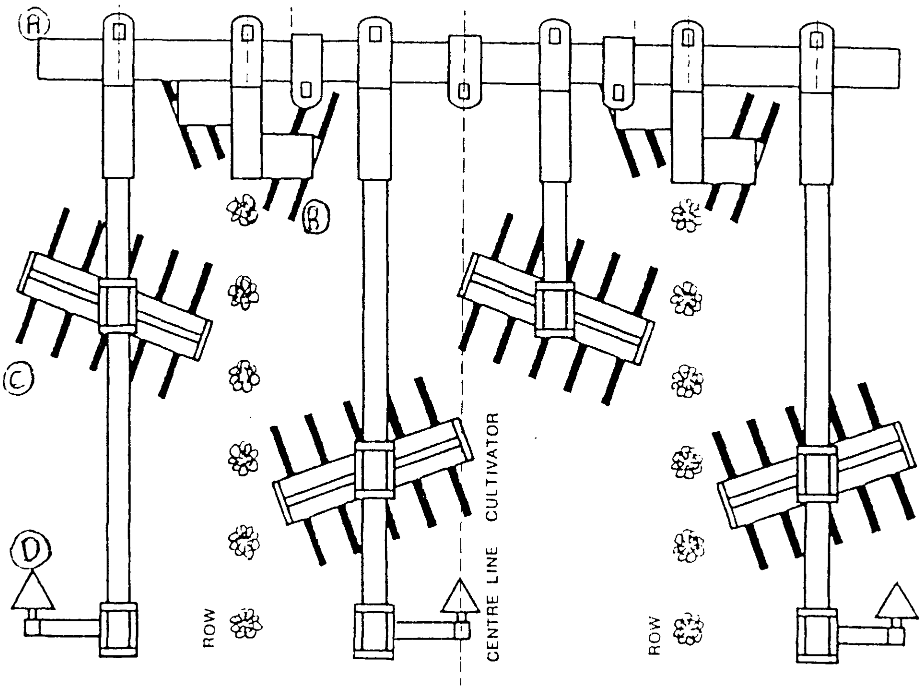



**Figure A2.3** Two row go lillistons, plan view. (A is tool bar, B is plant gang assembly, C is bed gang assembly and D is alabama sweep) (from Jetstream Ltd. rowcrop equipment catalogue (undated)).

Rip: deep tillage treatment in which tines spaced 1 m apart work at 0·45 m.

Set: a group of hills and furrows spaced 1 m apart equal to the width of rowcrop tillage implements. The set width in this project was 6 m prior to the 1986/87 season , and 8 m during the 1986/87 season. Wheel traffic is confined to two furrows in each set during rowcrop tillage operations.

## Reference

Hearn, A.B. (1985). Agronomic factors affecting micronaire. *The Australian Cottongrower* 6(3), 16-17.

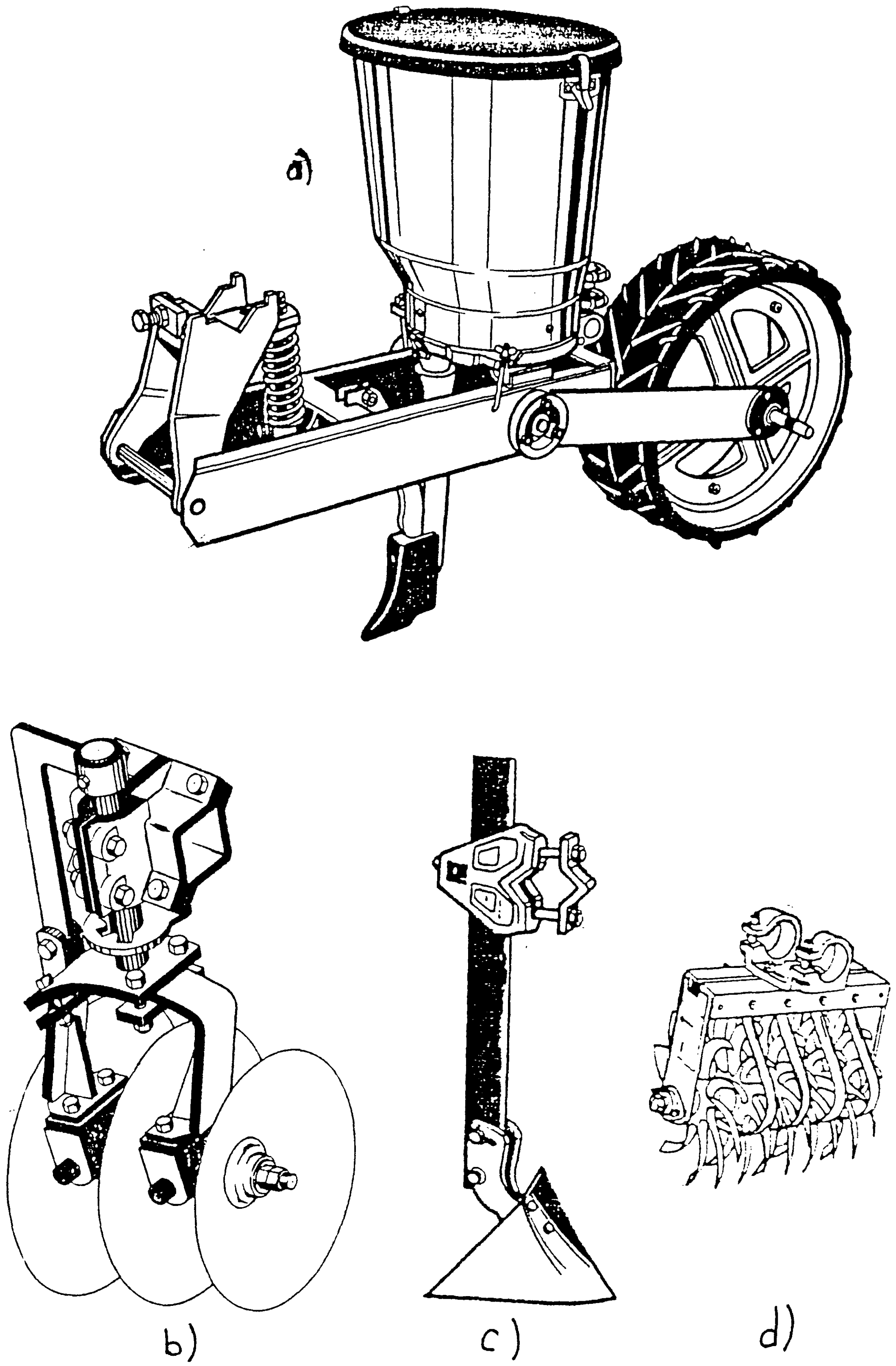



**Figure A2.4** Rowcrop tillage tools, a) planter, b) go devil, c) alabama sweep on shank and d) lilliston( a), b) and c) are from Napier Grasslands Ltd. rowcrop equipment catalogue (1986) and d) is from Jetstream Ltd. rowcrop equipment catalogue (undated)).

# APPENDIX 3

## Profile description at Field 30, Auscott, Warren

Landform: Flat
Landsurface: Periodic cracking and self-mulching
Microrelief: Man made ridge/furrow.
Disturbance: Cultivation and irrigated agriculture.
Described by Neil McKenzie November 1985.

CLASSIFICATION

| | |
|---|---|
| Soil Taxonomy: (sub-group) | Entic Chromostert |
| Soil Taxonomy: (family) | Entic Chromostert, fine, thermic, montmorillonitic. |
| Northcote: | Ug5.24 |
| Stace et al. (1968): | Grey clay |
| FAO/World Soil Map: | Chromic Vertisol |

PROFILE MORPHOLOGY

| Horizon | Lower Depth | Description (after MacDonald et al. 1984) |
|---|---|---|
| A1 | 0.28 | 7.5YR 4/2 heavy clay, moderately weak moist strength, moderately strong dry strength, normal plasticity and moderately sticky. Moderate structure grade with peds 10-20mm and subangular blocky. Rough ped fabric without cutans and cracks closed. Very fine to fine macropores (0.75-1mm) common with no medium to coarse macropores visible. Less than 2% calcium carbonate nodules and a field pH of 8.0. Many fine roots and a clear but irregular (because of cultivation) boundary to: |
| B21 | 0.65 | 10YR 4/2 heavy clay, moderately firm moist strength, very strong dry strength, normal plasticity and very sticky. Strong structure grade with peds 20-50mm and angular blocky. Smooth ped fabric with many slickensides and cracks closed. Very fine to fine macropores (0.75-1mm) common with no medium to coarse macropores visible. Less than 2% calcium carbonate nodules and a field pH of 8.5. Fine roots common and a diffuse but irregular (because of cracking) boundary to: |

| | | |
|---|---|---|
| B22 | 0.95 | 10YR 5/2 heavy clay, moderately firm moist strength, very strong dry strength, normal plasticity and very sticky. Strong structure grade with peds 50-100mm and angular blocky. Smooth ped fabric with many slickensides and cracks closed. Very fine to fine macropores (0.75-1mm) common with no medium to coarse macropores visible. Less than 2% calcium carbonate nodules and field pH of 8.5. A few fine roots and a diffuse but irregular (because of cracking) boundary to: |
| B23 | >1.40 | 10YR 5/3 heavy clay, moderately firm moist strength, very strong dry strength, normal plasticity and very sticky. Moderate to weak structure grade with peds 20-50mm and lenticular to angular blocky. Smooth ped fabric with slickensides common and cracks closed. Very fine to fine macropores (0.75-1mm) common with no medium to coarse macropores visible. Less than 2% calcium carbonate nodules and field pH of 9.0. A few fine roots. |